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# A Framework For Wireless And Mobile Global Communications System Integration: Architectural And Implementation Issues

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*Abstract*— **In recent years, most network providers needed a larger framework of mutually shared Technology. Therefore, many network manufacturers have begun to integrate other company's network components into their own communications network systems. Thus, making such systems possess complex nature and distinctive characteristics like different technologies, different architectures, different interfaces, different protocols, and access modes. Hence, we propose a framework for integrating space network and terrestrial networks. The framework must be capable of interconnecting a wide range of wireless access networks such as 802.11-based wireless LANs, cellular wireless, and satellite networks into a highly integrated wireless access platform. Our main contribution is the design of an architectural configuration of a wireless and mobile global communications network systems (as well as cellular networks).The issues of system integration, interoperability, and implementation are addressed. A case study of two models of System Integration was presented and compared.**

*Index Terms*— **Generic modeling framework, Global communications system Integration, Web-based systems and Applications (Web-Apps), The Public Internet, Wireless Access Platform, Wireless and Mobile Networks.**

## I. INTRODUCTION

In a traditional wide area networking, Cellular/mobile networks consist of several cells with each cell having a base station that handles mobile clients within the specific cell areas. There are limited base stations, and the communications between the base station and the mobile client is considered to be a single hop. This centralized nature of cellular networks, therefore, would not be efficient for satisfying most of the user's requirements.

Space communications networks and terrestrial communications networks can be integrated to form a Global communications Internetwork system that can bring any streams of bits into the ultimate multimedia portable units anywhere and anytime. Space communications networks will complement the roles of the terrestrial communications networks while the terrestrial communications networks will enable the communications products to aid in communications needs. The Internet is a giant packet switched network that consists of fixed networks (PSTN, ISDN, Frame Relay, X.25 and ATM) that are based on datagram approach to networking and it uses TCP/IP protocol. The evolution of fixed networks (PSTN, ISDN, Frame Relay, X.25 and ATM) and mobile networks (GSM, GPRS, and UMTS) have converged with IP as the common transport protocol to deliver end-to-end seamless services with high bandwidth in real time, security and Quality of Service (QoS) built-in [1]. The Internet and the World Wide Web (WWW) have drawn the general populace into the world of computing. Web-based systems and Applications (Web-Apps) deliver a complex array of contents and functionality to a broad population of end users.

Today, client/server architecture is the dominant form of systems design. As businesses form new alliances with customers and suppliers, the client/server concept continues to expand to include clients and servers outside the organizations. In a modern Wide Area Networking, Wireless and Mobile networks (as well as cellular networks) are typically characterized by different technologies, different architectures, different interfaces and different protocols and access modes [2]. This complex nature and distinctive characteristics constitute a hard problem when such types of systems have to be integrated into Global communications system architecture. The efforts produced to model a particular network technology by model-based analysis can be hardly re-used in other concepts. Hence, there is the need to resort to a generic modeling framework that is not restricted to the analysis and design of a particular class of wireless and mobile networks. It has been observed in [2] that the main modeling components of any network system can be identified with respect to the functions they perform without detailing how these models are actually built, or the used modeling formalism such that the "models" can interact with each other through model interfaces and protocols. This will enable us integrate a wide range of Telecommunications Architectural Models (both fixed and mobile) and computer architectural models, taking into account every possible system characteristics, system integration types, network components, and protocol types.

The recent literature contains numerous proposals for either integrating the IP Based LEO Constellation with the terrestrial mobile networks (GSM, GPRS) or the ATM Based LEO Constellation with terrestrial fixed networks (PSTN, ISDN, Frame Relay, X.25 and ATM). Many of these papers discussed in various architectural and protocols issues for the integrations [3], [4]. However, to the best of our knowledge, the important issue of integrating all these networks with the Web-based computer systems and Applications (Web-Apps) models being converged with IP as the common transport protocol has not been addressed so far. Our goal is to integrate

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the ATM Based LEO Constellation with numerous terrestrial networks, both fixed and mobile.

The remainder of this work is organized as follows. Section 2 sets the stage for our solution by analyzing the traditional Wide Area Networking Model reference architecture. In section 3, the needs for the modifications of the reference architecture network are discussed from both the users and system requirements perspectives. Section 4 spells the detailed design of our new system architecture based on the system requirements. Section 5 presents our view of the protocol to be implemented in our new system architecture. The Conclusions and recommendations are drawn in section 6.

## II. OVERVIEW OF THE REFERENCE WIDE AREA NETWORKING MODEL (RWANM)

We use the Reference Architecture shown in fig 1[5] to design an architectural configuration for our modern Wide Area Networking Model. The reference architecture presents how users are connected to the Internet and the servers. We use the block diagram technique to analyze it.

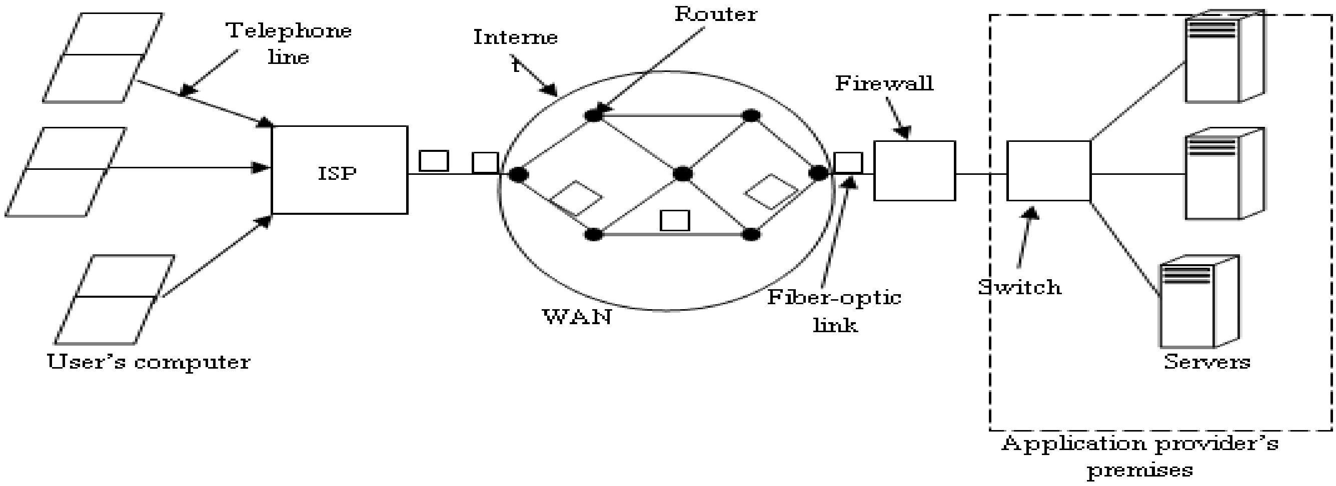


Figure 1: The Reference Wide Area Networking Architecture [5]

The reference architecture is composed of the following components:

*The users:* The end users which include nodes (i.e. computers) from another network or data center. The user's computer is typically connected to the ISP through either a 56kbps dial-up modem or Asymmetric Digital Subscriber Line, (ADSL), Cable Television, etc. to the Internet. The user's computer breaks the data to be sent to the server into chunks of data called packets, typically 64 to 1,500 bytes.

*User's Internet Service Provider (ISP or the Access Nodes)*

The user's packets are sent from the source machine to the user's ISP (Internet Service Provider or Access nodes).They are in-charge of the flow control of the incoming transfer requests of data from the servers [6]. The ISP is a company that offers Internet access to its customers. The ISP has a high-speed (usually fiber-optics) connection to one of the regional or backbone networks that comprise the Internet.

*The Core Nodes (Or the Public Internet)*

In the Internet, data packets are sent through one or more router's memory and then forwarded to the next router along the path as soon as the needed transmission line is available. The user's data packets are forwarded hop-by-hop across the Internet until they arrive at the web server. This technique is called store and forward packet switching. The Internet is a giant packet switched network that are based on datagram approach to networking and it uses TCP/IP protocol. They consist of core nodes (or specialized computers called routers) connected by wires or optical fibers as shown in the middle of figure 1. The core nodes are in-charge of content switching and resource reservations [6]. The considered resources are the bandwidths, memory space, central processing unit (cpu) cycles, memory input and output speeds. Note that RAM devices are used for store and forwarding.

*firewalls*

Most application providers offering web services have a specialized computer called a firewall. In computing, a firewall is a network security system that controls the incoming and outgoing network traffic based on an applied rule set. It filters all incoming traffics in an attempt to remove unwanted packets (e.g. from hackers trying to break in) [7]. Firewalls, exist both as software to run on general purpose hardware appliance or a combination of both. Many hardware based firewalls also offer other functionality to the internal network they protect, such as acting as a Dynamic Host Control Protocol (DHCP) server for that network. Firewalls fall into four broad categories [8]: packet firewalls, circuit level gateway firewalls, application level gateway firewalls, and stateful multilayer inspection firewalls. See [8] for details.

*An Ethernet switch*

The firewall is connected to the LAN typically an Ethernet switch, which routes packets to the desired server in the Application provider's premises**.**

*The World Wide Web (WWW)*

Web-based systems and Applications (Web-Apps) deliver a complex array of contents and functionality to a broad population of end users. As a consequence, most computers nowadays are connected to a network or the Internet.

## III. THE NEED FOR MODIFICATIONS OF THE REFERENCE (OR BASIC) ARCHITECTURE NETWORKING

Currently, the success of Internet applications moves toward mobile platforms (e.g. commerce, learning, games, preview of attractions, trading, messaging, web browsing, etc) and also towards end users. Many people have developed interest over a light weight, portable device that acts as a telephone, CD player, DVD player, e-mail terminal and web interface gaming machine, word processor, and the more all with world-wide wireless connectivity to the Internet at high bandwidth. There are many new classes of services arising from simultaneous use of multiple interfaces that use scenarios involving a single host as well as more than one host. Therefore, we assume that the Basic Wide Area Networking model shown in figure 1 cannot meet the needs of the present day user's requirements. So, functional and Architectural modifications and enhancements are needed in order to fulfill the specific objective to guarantee certain level of performance to support high speed network access, bandwidth, and throughput in wireless and mobile networks.

### A: *System Design Considerations*

It was stated in [9] that users would want highest quality of services at the lowest cost as well as one network for all applications. Service providers on the other hand would want: A global wide area network; Seamless compatibility with advanced digital terrestrial broadband (fiber) network; Supply of instant infrastructure providing availability of advanced fiber like services to almost 7 billion of the world population; System capacity that is not rigidly dedicated to particular end users or locations; Provision for missing and problematic links everywhere facilitating economic and social development in rural and remote areas; Play a complementary role to terrestrial wireless networks; Be a broadband overlay for narrow band cellular systems; be a backbone infrastructure for cell site interconnect and backhaul for long distance and international connections; among others. A successful Global communications Internetwork system will be the one to integrate all these issues.

### B: *System Requirements/ specifications*

B1: *System Requirements.* System designers start with the total System Requirements/ specifications for a new or improved telecommunications capability and end-up engineering and planning for the detailed physical components [10]. The total system Requirements/ specifications of our system are as follows [10]: (i) Topological requirements. This includes maintaining a minimum of two connected networks against any failure of a single node or link.(ii) Protocol requirements. This includes dynamic routing protocol to reroute traffic against transition of network dimensioning or equipment failures. (iii) Bandwidth allocation requirements. These proactively allocate extra bandwidth to avoid traffic loss under failure conditions. (iv) System Coverage capacity which includes: radio ports for handling traffic and application points (or base stations) for coverage; (vii) Management and complexity issues which include: Connection management, Link reliability management, and Power management.

B2: System specifications; System specifications are the basis for design. So, we enumerate the Telecommunications system performance measures such as: **(a)** QOS indicators which include: signal to interference ratio (SIR), Packet error rate (PER), and Bit error rate (BER); (b) Grade of Service **(**GoS) indicators which include: Call blocking probability, Call blocking rate during the peak hours, Availability of resources, and Unacceptable quality; (c) Miscellaneous indicators includes: Delay in call set-up, Database look-up time.

## IV. DESIGN OF A FRAMEWORK FOR WIRELESS AND MOBILE GLOBAL COMMUNICATIONS SYSTEM INTEGRATION

We adopt the system design methodology known as the top-down (or modular) engineering approach to modify and enhance our reference architecture of figure 1. The approach has three steps [11]; Step I: Description of services from end users (customers and service providers) perspectives. (This has been done in Section 3); Step II: Information flow between network entities (i.e. network protocols, interfaces and interoperability) to support the users services (This is discussed in Section 4); Step III: Protocol application of the information flow (This is discussed in section 5).

### *IVA Global Network System Interconnectivity types*

As service providers acquire holdings around the world, there is intense pressure to integrate architectural components and operations by different levels of integration [12]. The level of integration could be as simple as routing all operations to a common central point (common software platform) or complicated as using the same set of hardware in multiple systems (common hardware platform) to support multiple technologies. Depending on the level of integration that is necessary, numerous approaches can be taken to combine different Radio Access Technologies (RATs) or Core Networks. When the integration between different technologies is close, the provisioning of the service is more efficient. Also, the choice of the mode in order to find the best radio access (or Core Network) is faster [13]. This could, for example greatly affect real time flows. On the contrary, a higher level of integration means providing a greater effort in the definition of interfaces and mechanisms that are able to support the necessary exchange of data and signaling between RATs (or Core Networks). The details of the Network System Interconnectivity types are given as follows:

*(a) Simple Integration.* We classify this level of integration under four methods namely [13]:

*(i) Open coupling*. This scenario is an open standard and it is used for access and roaming. There is no real integration effort between two or more access technologies. The satellite, Internet, UMTS, and 802.11/HIPERLAN-2 networks can be considered as different independent systems that can share a single billing centre, the Message Centre (MC) and Authentication Centre (AC) between them. Although a common database can be used between the different networks, separate authentication procedures, different RATs may be used. Hence, seamless handover will never be possible.

*(ii) Loose Coupling.* This is defined as utilization of a generic RAT (WLAN in our case) as an access network complementary to current 3G access networks. In this scenario, there is a common customer database and authentication procedure. The operator will still be able to utilize the same subscriber base for existing 3G clients and new RATs for (WLAN) clients, allowing centralized billing and maintenance for different technologies. It utilizes the common subscriber database without any user plane, lu interface, i.e. avoiding the Serving GPRS Support Node (SGSN), and Gateway GPRS Support Node (GGSN) nodes. This is the most attractive solution as at present.

*(iii) Tight Coupling,* The key characteristic of this scenario includes the possibility of seamless handover between different networks and it requires additional standardization. The generic RAT network is connected to the rest of the UMTS network (the Core Network using the lu interfaces by means of interworking unit (IWU). Tight coupling interworking uses lu interface between different radio access technologies making vertical handover possible.

(iv)*Integration,* This method requires seamless handover. However, in this case a WLAN can be viewed as a cell managed at the Radio Network Controller (RNC) level. In the satellite/terrestrial integration, Satellite Iridium model is tightly integrated with GSM Suite; Satellite Global star model is also tightly integrated with the terrestrial CDMA Network.

*(b) Complex Level of Integration*

The complex level of integration uses the same set of hardware in multiple systems (common hardware platform) to support multiple technologies. For instance, handover initiation (whether to start HO or not), Handover decision (selection of HO type and new access point) and Handover supervision (coordination of control/user plane mechanisms during HO execution) are under the control of the mobile network for circuit-switched services with stringent delay requirements, while that for packet-switched services are under the control of the mobile device (alone or with the cooperation of the mobile network [14].

IVB: *Block Diagram Design Model*

The following wireless and mobile network system integrations are possible: Integration of the broadband ATM satellite Systems and the Internet, Integration of satellite and mobile networks (2G/3G/ Cellular Networks), The Integration of Internet and WLAN/LAN, The integration of WLAN and HIPER-LAN-2 and UMTS cellular network, the integration of Internet and mobile networks such as UMTS networks /WLAN/LAN/ HIPER-LAN-2; The integration of cellular telephone system and PSTN. These possibilities enable different networks to allow users on any of them to communicate with users on all the other ones. The summary of the possible wireless and mobile network interconnections is given as follows while the reader is referred to [15] for the details.

(i)Integration of the broadband ATM satellite Systems and the Terrestrial Networks

Requirements /Features:

The wireless and mobile network interconnections can be made possible either through Gateway Earth Stations (GESs), Interworking functions (IWFs) or through adaptation units as shown in figure 2.

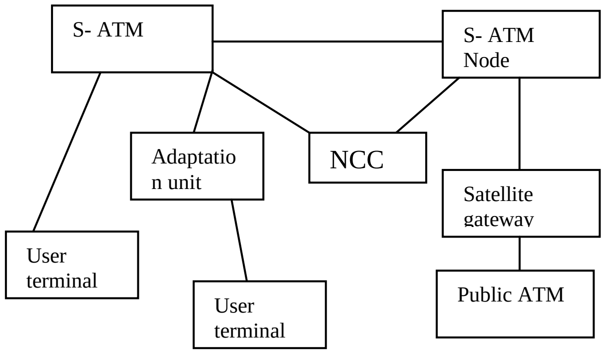


Fig.2 *Functional model diagram of* Global Communication Satellite System

The LEO satellite network architecture with ATM-based on-board switching, on-board processing and inter satellite links (ISLs) is presented in figure 2. A mobile terrestrial user with a low power handset can connect to one of the mobile satellite nodes covering their location area through satellite gateways, Interworking Functions (IWFs), and adaptation units to communicate from anywhere on the surface of the earth even where no telephone infrastructure existed [16]. The connectivity between satellites is provided by inter-satellite links (ISLs). The user terminals (UTs) are assumed to be capable of supporting several different protocol standards including ATM User Network Interface (ATM-UNI), Narrowband Integrated Services Digital Network (N-ISDN), Frame-Relay UNI, TCP/IP, among others [14]. The user terminals are connected to the ATM LEO satellite system directly or by means of satellite Adaptation Units (SAUs) through one of the supported standard interfaces. For connections between satellite users, the gateway only acts during setup process. The connections between satellite users and terrestrial users must be handled by gateways [17]. Thereafter, the end-to-end connection is transferred through the space segment. The procedures implemented in the gateway earth stations are call-setup, billing, registration, etc.

*(ii)Integration of satellite and mobile Networks (2G/3G/ Cellular)*

*Requirements/Features:* All LEO satellites providing mobile telephone services use on-board processing with switched beam technology. It has a base-band transponder which is a transceiver, with Ka-band cross links, a satellite to satellite high- bandwidth microwave or laser that makes it possible to bypass the terrestrial fiber or copper networks. It requires steerable cross link antennas and receivers, transmitters and control hardware. Two examples of satellite network models that use on-board processing with switched beam technology are described here as follows:

*Iridium Satellite mode.* It uses satellite switched TDMA multiplexing of signals to cover entire coverage zone and this can increase the throughput of a transponder [18]. It provides circuit-switched telephony service, dial-up through satellite to

ground internet gateways on any spot in the earth [19]. It is a tightly integrated GSM protocol suite which can easily integrate with existing GSM services.

*Teledesic Satellite model.* The model uses a connectionless-oriented 288 LEO satellites in the constellation to provide a complete world data communications system above the surface of the earth using fiber-optic cables on satellites, instead of on the earth's surface,. These requirements dictated the use of wideband data links, on-board processing, and ISL links. Any user can access any other user or ISP [Internet Service Provider] independent of location and the existing telecommunications infrastructure. The Teledesic model employs ATM-based model with adaptive routing protocol. An ATM technique permits the use of Application Specific Integrated Circuit (ASIC) chips to be employed for ATM networks as well as user terminals. Direct access to ISP is available via optical fiber where an Internet access satellite can concentrate its services on less well populated and rural areas [18].

*(iii) The Integration of Internet and WLAN/LAN*

Requirements /Features: The Internet uses routers rather than the PSTN switches to interconnect data terminals (computers) around a large geographical area. It uses point-to-point protocol as the primary link protocol over the point-to-point lines. PPP is a multiprotocol framing mechanism suitable for use over MODEMS, SONET and other physical layers. In the data link layer, we find bridges and switches, which can accept frames, examine the MAC addresses and forward the frames to a different network while doing minor protocol translation in the process, for example, from Ethernet to FDDI or to 802.11. At the physical layer of the WLAN/LAN, the Application Points (APs) are required in the BSSs to constitute a distribution system which can be any of this IEEE 802.11: (802.11a, 802.11b, 802.11 infrared, 802.11 FHSS, 802.11 DSSS, 802.11 OFDM, 802.11b HR-DSSS, 802.11g OFDMA) WLANs. To achieve true mobility, the use of short-range radio waves (or infra-red) is required.[18].

(iv)*The integration of WLAN and HIPER-LAN-2 and UMTS cellular network*

Requirements/ Features: In centralized topology, a connection between the mobile station (MS) and the AP are similar to that of 802.11, but communications between the APs are different. The 802.11 with IP-based subnet allows communications with one another while the HIPER-LAN-2 allows both handover in a subnet and IP-based handover in a Non-homogenous network. The HIPER-LAN-2 uses a new protocol stack architecture that is similar to the voice-oriented cellular networks. At the physical layer, it uses OFDMA modulation that adds the preamble of the DSSS IEEE 802.11 to its own logical channels similar to GSM or TDMA systems. At the Data Link Control (DLC) layer, the MAC sub layer is a dynamic TDMA/TDD that is similar to the PCS-oriented fixed access assignment method and this defines a priority scheme and a lifetime for each packet. The convergence layer to DLC capabilities provide a number of services such as segmentation and reassembly, priority mapping from 802.11 address mapping to 802.11 multicast/broadcast handling, and flexible QOS classes [20]. This generic architecture allows seamless interoperation with Ethernet, point-to-point protocol connection (e.g., the OFDMA Modem Connections), UMTS cellular network, IEEE 1394 (e.g. Fire wire i-link) for entertainment systems and ATM-based networks. These features allow manufacturers to support vertical roaming capability over a number of networks.

The adoption of a single generic interface, lu, between the UMTS radio access and the UMTS core network segment would ease the inter core network roaming requirements by introducing greater commonality. Of course, the first choice element aiming at a common interface concerns the interworking functions (IWFs) and Functionality associated with the core network. Hence, adaptation role would then be assigned to the core networks. The lu interface takes into account both the fixed networks and the LAN/WLAN enhancement processes that would naturally drive the evolution of the LAN/WLAN towards UMTS convergence.

*(v)The integration of cellular telephone system and PSTN*

*Requirements/ Features:* Wireless networks can directly interconnect with the PSTN to support wire line to wireless (and vice-versa) line calls, or to support wireless to wireless calls. Some wireless networks directly interconnect with other wireless networks to support wireless to wireless calls. Wireless network interconnection with the (PPDNs) is also possible.

In [21], the basic building blocks of SS7 network are namely: Signaling Points (SPs), Signaling Transfer Points (STPs), and Signaling Links. Besides, the uses for signaling SS7 messages are specified to support OAM & P of the GSM network and also for an alphanumeric messaging service known as SMS. SS7 is the out-of-band signaling where a common data channel is used to convey signaling information related to a number of trunks throughout the world. It is used for both circuit-related and non-circuit-related cases. GSM uses the followings 23[24]: Circuit-related signaling for call-set/release between GSM and PSTN; Circuit-related and non-circuit related signaling for intersystem handover; Non-circuit related signaling for automatic roaming. The interworking between the GSM network and packet data network is not defined in the GSM specifications. However, there must be a voice modem in the MSC that functions at the correct rate, to connect with a voice-modem in the analog wire line network. At the MSC, the analog modem must support 300-96,000 band analog connections to the modems in the wire line network. Support for data rates higher than 96,000 bands requires that GSM phone use multiple time slots and aggregate the slots to deliver the higher data rate. The use of multiple time slots is equivalent to the use of multiple phones by the same user and therefore reduces the capacity.

*IVC: AN ARCHITECTURAL FRAMEWORK FOR WIRELESS AND MOBILE GLOBAL COMMUNICATIONS SYSTEM INTEGRATION*

We modify and enhance the reference (or basic) architecture of figure 1 by adding new features that make up the new system by using the top-down (or modular) engineering approach as well as the system integration types discussed in sections 3 and 4. The new system then has five modules (or functional Units): The users and cellular/mobile network unit, Telecommunications network providers unit, Network carrier's unit, management unit, and Web-based

systems and applications (Web-Apps) Unit. The details of each module are given as follows:

*The users and cellular/mobile network Unit*

In this unit, user's components with multi-access techniques ( full- duplex type ) in the air interface is introduced as shown on the Left most side of figure 3. The communications between the base stations and the Internet has to be of multi-hop nature. The transfer of traffic between the base stations and the Internet has to take place from the base stations through the highly integrated wireless access platform and the border gateways /routers. With this, there will be greater flow of the Internet traffic from the ingress node to egress node. This includes traffic that remains within a single service provider's network as well as traffic that crosses private peering points. Fixed internet traffic refers perhaps to traffic from residential and commercial subscribers to ISPs, cable companies and other service providers, while Mobile/Internet Traffic refers perhaps to backhaul traffic from cell phone towers and providers [22].

*Telecommunications network providers unit*

For cells which cannot be connected directly to the wireless hot spot (WHS), a possible connection path can be done using access nodes (see figure 3). A wide range of Telecommunications Architectural Models (both fixed and mobile) have been combined into a wireless overlay network to provide most of the user's requirements.

*Network carrier's unit*

In this unit, a broadband ATM satellite backbone network and the Internet back bone are integrated. The transfer of traffic between the broadband ATM satellite network and the Internet has to take place through the border gateways /routers. A multiprotocol router can connect two networks and can handle multiple protocols; The Internet uses routers rather than the PSTN switches to interconnect data terminals (computers) around a large geographical area. With this, there will be greater flow of the Internet traffic from the ingress node to egress node. Hence, there is the need to design IP-core networks to acquire connection-oriented properties. It has been observed that Internet traffic data from the public peering points can give an indication of Internet volume and growth, but these figures exclude traffic that remains within a single service provider's network as well as traffic that crosses private peering points.

*Management Unit*

The Network Management System involves the following components [14]: The Network Control Centre (NCC), on which the network management applications reside, a set of managed S-ATM Nodes (LEO Satellites), a Set of management channels (mVC/PVPs), and network management protocols used to exchange management information. The Management Unit consists of both Network Control Centre (NCC) workstation and the Network Management System (NMS) Sub system units.

The Network Control Centre (NCC) is the central entity that provides the overall control of the satellite network resources and operations. The NCC is responsible for the following tasks [14]: user management**,** billing and accounting**,** location management register**,** location management handoff**,** performance management**,** software update**,** global resource management (e.g. overbooking, PVP management, routing table management) according to a long term resource planning scheme. The first three functions can be organized in a user Database storing information about the users connected to the network specifying for example, authorization, privileges, etc. A centralized Network Control Centre (NCC) workstation attached to a reference terminal performs network control and also runs the Network Management System (NMS) server.

Multiple NMS browser clients may connect to the NMS server with predefined authentication and access privilege levels for complete or restricted views of the network. The NMS includes an easy to navigate, hierarchical set of screens for network configuration, status, alarms, performance, and security functions.

**Web-based systems and applications (Web-Apps Unit)**

The World Wide Web (www) and the Internet have drawn the general populace into the world of computing. Web-Apps are Multi-computer-based web servers.

A high level model of Global Communications Internetworked System Architecture for Web-based Systems and Applications that integrates ATM satellite constellation network, five other terrestrial networks, ,all the identified functional requirements, possibilities, operating environments and system integration types is shown in figure 3.

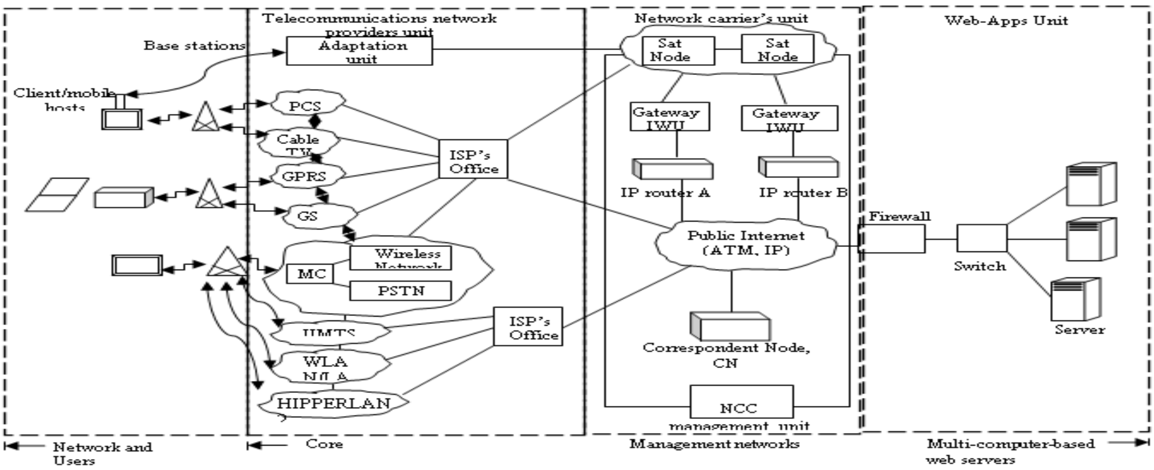


Fig.3: A high level model of Global Communications Internetworked System Architecture for Web-based Systems and Applications.

## V. Protocol Applications

### *V.A Internetworking Problems*

When packets sent by a source on one network must transit one or more foreign networks before reaching the destination network (which also maybe different from the source Network), many network problems can occur at the interfaces between networks. Some of the problems include [19]: (i) When packets from a connection-oriented network must transit a connectionless one, they may be re-ordered, something the sender does not expect and the receiver is not prepared to deal with; (ii) Protocol conversion will often be needed, which can be difficult if the required functionality cannot be expressed; (iii) Differing quality of service(QoS) is an issue when a packet that has real-time delivery constraints passes through a network that does not offer real-time guarantees, among others. Also two major problems exist with the use of gateways to separate space networks from the ground based networks [20]. First, the gateways are single point of failures and are not suitable for mobile communications in rural areas without ground based infrastructures. All these problems need to be solved.

### V.B The implementation Issues

A set of operational interworking functions to provide interworking between two (or more) networks be provided across any two networks involves three areas [1l]: radio system management, and call processing

***(i)*** *Mobility management* – This involves Protocol Conversion that provides the translation of messages and parameters from one protocol to the other. For example, Multiprotocol label switching (MPLS) approach has been designed for the Internet backbone networks, as well as an interesting candidate for satellite networking. *(ii) Database Mapping.* This provides the translation and management of information elements that allow each of the application protocols to provide user service (e.g. subscriber identification, location, status information; For example, interworking functions require primarily Home Location Register (HLR) procedures to perform such operations. (iii) *Transaction Management.* This enables the completion of queries between the two (or more) networks (e.g. re-originating and maintaining queries and responses from one network to the other. An intersystem handoff involves a handing off call between two different radio technologies at the anchor and target Mobile Switching Centers (MSCs). Other features include: call forwarding (unconditional busy, and No answer), call waits, three-way calling etc.

The implementation of these functions also requires radical changes in many functional entities. Although, total compatibility between two (or more) networks may be lacking, there is still benefits to provide basic wireless functionality through interworking for subscribers who can only receive nationwide coverage at least in the short-time.

### V.C: A *Case Study of system integration of two internetworking models*

In this sub section, we take a closer look at the two internetworking models of the concatenated virtual circuit model and the connectionless (or datagram) model. An important feature of the first approach is that a sequence of virtual circuits is set up from the source through one or more gateways to the destination. Each gateway maintains tables telling which virtual circuit passes through it, where they are to be routed and what new virtual-circuit number are [23]. Hence, multi-hop routing is possible. In the second approach, datagram from one end host to another end host can also pass through the same or different routes through one or more gateways from the source to the destinations. Hence, multi-hop routing is also possible. Another important and distinguishing feature is that the routing decision on the datagram approach is made separately for each packet possibly depending on the traffic at the moment the packet is sent. This strategy can use multiple routes and thus achieve a higher bandwidth than the concatenated virtual-circuit model that uses only one route. Therefore, multi path routing is possible. In summary, the two ways of internetworking can be compared as follows: in the concatenated virtual-circuit approach, it has the disadvantages of table space being required in the routers for each open connection, no alternate route routing to avoid congested areas, and vulnerability to router failures along the path. It is difficult, if not impossible, to implement, if one of the networks involved is an unreliable datagram network. Datagram approach, on the other hand, has more potential for congestion, but also more potential for adapting to it; robustness in the face of router failures but longer headers is needed. As a datagram network, data are packetized and each packet carries an address in the header. However, the address in the header is a local address and not a global address. A major advantage is that it can be used over subnets that do use virtual circuits inside [23]. Hence, there is the possibility to design IP-core networks to acquire connection-oriented properties as well as multi path routing.

## VI. Conclusions and Recommendations

In this paper, we have identified new classes of services arising from simultaneous use of multiple interfaces, Users / Network Service Providers design considerations, the total system requirements/ specifications of modern wide area Networking model, and many network problems that can occur at the network interfaces between networks that are typically characterized by different technologies, different architectures, different interfaces and different protocols and access modes [2]. we have used a generic modeling framework to take care of the problem of when packets sent by a source on one network must transit one or more foreign networks before reaching the destination network (which also maybe different from the source Network); such that the “Architectural models” (both fixed and mobile) can interact with each other through model interfaces and protocols. We adopted the system design methodology known as the top-down (or modular) engineering approach to modify and restructure our reference (or basic) architecture into a high level model of Global Communications Internetwork System Architecture in wireless and mobile networks; We went on to propose an architectural configuration for a modern Wide Area Networking Model that combines a wide range of wireless access networks such as 802.11-based wireless LANs, cellular wireless, and satellite networks to provide a highly integrated wireless access platform. Then, we took a closer look at one of the problems which occurs when packets from a connection-oriented network must transit a connectionless one, and we observed that it is possible to design IP-core networks to acquire connection-oriented

properties with IP as the common transport protocol to deliver end-to-end seamless services with high bandwidth in real time, security and Quality of Service (QoS) built-in. Hence, we argue that it is possible to implement the multi-hop routing as well as multi path routing. We then argue further that since multi-hop as well as multipath routing is feasible in datagram internetworking, multipath routing based on traffic is also feasible. However, multipath routing based on datagram internetworking is not suitable for Traffic Engineering and efficient resource allocation. Then, we plan to modify our network architecture to support Traffic Engineering and efficient resource allocation. Such modifications will introduce an advanced wireless network known as Wireless Mesh Network (WMN). A wireless mesh network provides a better solution to problems that often arise in cellular and WLANs. The basic problem for both cellular and WLANs is that both have limited range of connectivity. These technologies are quite expensive and data rate of transmission is quite low. In contrast, wireless mesh networks are relatively cheap and provide better data transfer rates. The future will be the usage of wireless mesh networks. The Gateway Earth Station (GES) at the transport layer can interface between two different transport protocols by essentially gluing a TCP connection to an ATM connection transport connections.

## REFERENCES


[1]Miroslaw Klinkowski and Marian Marciniak, Optical Packet Switching: Approach to Performance Modeling and Simulation.

[2]Paolo Lollini, Andrea Bondavalli Felicita Di Giandomenico. A general Modeling Approach and its application to a UMTS network with soft-handover mechanism, technical report RCL060501-University of Firenze, Dip. Sistemi E Information, May, 2006

.[3]Petia Todorova, Network management in ATM LEO Satellite Networks, Proceedings of the 35th Hawaii International Conference on System Sciences – 2002.

[4]H. Y. Chen, Jim Hutchins, and Bruce Mah. A light weight, link layer, source-based routing protocol for LEO satellite networks

.[5]Andrew S. Tanenbaum, Structured Computer Organisation,5th edition, Pearson Education, Inc.,Upper Saddle River, NewJersey 07458 pp568.

[6]Christopher Michard,Yosuke Tanigawa,Hideki Tode. Deployment of the Content-Based Switching Network, Communications and Network, 2014, 6, 29-42 Published Online February 2014 (http://www.scrip.org/journal/cn,http://dx.doi.org/10.4236/cn.2014.61005

[7]Appliger H.T. and Rolf E.T. 'Internet Security: Firewalls and Beyond",Communicatios of the ACM 40 (5):94,doi:1145/253769.253802.

[8] www.Internetsec.org/firewallstypes.

[9], I. Mertzanis, G. Sfikas, R. Tafazolli, and B. G. Evans, "Protocol Architecture for Satellite ATM Broadband Networks", IEEE Communications Magazine, March 1999,,46-54.

[10] Houston, H. Carr and Charles A. Synder, The management of Telecommuncations, second edition, McGraw-Hill / Irwin, New York, 10020,pg 531.

[11] Randall A. Snyder and Michael D. Gallagher, Wireless Telecommunications Networking with ANSI-41,2nd edition, McGraw-Hill TELEOM ENGINEERING, New York,2001,pg41,447.

[12]Vijay K. Garg, Joseph E. Wilkes, Principles and applications of GSM, Pearson Education, Inc ,India, 1999, Pg 443, 386.

[13]Reshan Samarasinghe, Vasillis Friderikos, A. H. Agbamic, Analysis of Intersystem Handover: UMTS FDD and WLAN.

[14]Tiziana Toniatti, Francisco Meago, Alberto Pericciolі, Shientaro Uno, Eranga Perera, Roksana Boreli, Advanced Handover Management in Ambient Networks,Intrenational workshop on convergent Technologies (IWCT) 2005.

[15]Eke Vincent O.C., and Eke Christopher Ifeanyi. International Journal of Electronics and Computer Engineering, Volume 6, Issue 4, ISSN (Online):2249-071X, ISSN (Print):2278-4209.

[16] Anton Donner, Matteo Berioli, and Markus Wermer, "MPLS-based satellite constellation networks" IEEE Journal on selected areas in communications, vol. 22, pp. 438-448, April, 2004.

[17]Hoang Nam Nguyen, Jon Schuringa and Harmen R. Van As, " Handover schemes for QOS Guarantees in LEO-satellite ATM Networks, 0-7695-0777-8/00810.00@2000 IEEEE.

[18]Pratt,T., Bostian,C., and Allnut, J.(2003) Satellite Communications, Second Edition, John Willey and Sons Inc.,New York Pg 246 -248.

[19]Amine M. Houyou, Richard Holzer, Hermann De Meer, Michael Heindl, Performance of Transport Layer Protocols in LEO pico-satellite constellations technical report MIP-0502, December 2005.

[20] Vijay K. Garg, Joseph E. Wilkes, Principles and applications of GSM, Pearson Education, Inc ,India, 1999, Pp 294.

[21] Behrouz A. Forouzan and Sophia Chung Fegan, Data communications and networking, 4th edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, Pp 216-227,775-776. [22] William E.; Gilbert, P.; Chun, B. G.; Cox, L. P.; Jung,J.; Mc-Daniel, P.; and SHeth, A. N. (2010), Taint Droid: An Information-Flow Tracking System for Realtime Privacy Monitoring on Smart-Phones. In 9th USENIX Symposium on Operating Systems Design and Implementation. [23] Andrew S. Tanenbaum, Computer Networks, fourth edition, Pearson Education (Singapore) Pte. Ltd/. Delhi. 110092, India, pp 19,424, 469